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WHOLE No. 433

A PHYSICIAN'S TRIBUTE TO THE CLASSICS

On April 25, 1922, the Medical Society of the State of North Carolina met at Winston-Salem. The President, Dr. Hubert A. Royster, of Raleigh, delivered an address on *The Real Things in Medicine*. The address was published in *The Journal of the American Medical Association*, on August 5 (79.424-428). Some extracts from it will be of interest and of value, directly and indirectly both, to students and teachers of the Classics.

Brains are the alpha and omega of the man of medicine. . . . The study of medicine bestows no more brains and adds not one cubit to the mental stature. It provides only a few more implements of the mind to be used for good or for ill. Unless the roots are deeply planted in the soil of real learning, the study of any science narrowly pursued takes away from the natural resources of the mind more than it puts in. In other words, a finely endowed intellect is needed to carry on in the realm of science, to withstand its temptations toward the illogical, to keep clear headed in the midst of fact and fancy. . . .

Make no mistake about culture. Culture is refinement, accuracy, poise, resourcefulness; it is not effeminacy, weakness, conventionalism, impracticability. We have been getting too far away from the humanities, from classical education, from academic scholarship, if you please. In the quest of science—and there is no nobler pursuit—we have set up utilitarian courses, called premedical and certainly premeditated, for the purpose of reducing to a minimum all those things which do not bear directly on the matter in hand, and swelling to a maximum those that are concerned in the material things of medicine. In this we have left out the very bed rocks of learning: the capacity to interpret the phenomena and the power to express the findings. If the average trained laboratory worker in our country today has any weakness, it is his inability to convey his ideas, to put down what he has done, to express his results in terms clear and terse. Generally his work surpasses his words. And it is not the misfortune of the individual, but of the plan which essays to substitute scientific research for sound scholarship; to get the one without the other, when we may have both. It is the common failing of the later generation of medical men that they do not write so lucidly or think so accurately as those just before them. There are, of course, numerous and notable exceptions. But the observation is probably correct, and its explanation lies in the small stress placed on actual scholarship required of one entering the profession of medicine.

We are living in an age of inaccuracy. We are inaccurate in thought, in speech, in spelling, in writing. We know a great deal; but do we know anything very well? Short cuts and practical preparation are the order of the day. Language, the only medium through which thoughts are given out, has been almost forgotten. Will it be considered very old fashioned if I should suggest that the neglect of the languages, and particularly the banishment of Greek, may be responsible for our loose thinking and our lack of scholarship? The value of Greek for the medical student

might be a theme for a discourse in itself. If you should go over the evidence, you would be surprised to find how much medicine owes to the Greek language, what a very large number of our words referring to diseases, operations and organs are derived from the Greek—fully as many as from Latin. And many of those coming through the Latin were taken originally from Greek. "We suspect, too, that our men of science who are supposed to be opposed to 'so much Greek' must study that language secretly or they assuredly could not name the tools of their own trade". The chief advantage of the study of Greek is a training in accuracy, in the expression of nice shades of meaning, the very essence of a cultivated mind engaged in scientific thought. We cannot divorce science and culture; we cannot go on rearing a race of seekers after truth who are not trained thinkers; we cannot fail to perceive that the education of a candidate for a learned profession means for us, as it has meant for all the older nations, a thorough grounding in the ancient and honorable arts and classics before we approach the special study needed for our dignified calling. That way trod our great fathers, who outstripped us with the means at their disposal; that way lies our hope of elevation, of bringing back the well rounded medical man and adding to him the marvellous scientific attainments of the present age. My thought was expressed by Thomas L. Stedman, in these words: "Some day the pendulum will swing the other way and a new renaissance will once more join culture to knowledge to make the perfect physician".

Utterances like those of Dr. Royster, especially with respect to the inability of scientific men to express themselves in English, have appeared from time to time in *THE CLASSICAL WEEKLY*. Witness vigorous remarks by Dr. W. H. D. Rouse, in an article entitled *Learning English through the Classics*, 6.17-18, 25-26, by Mr. Paul Elmer More, and more especially by Mr. T. A. Rickard, of the Royal School of Mines, London, Editor of a United States technical journal, in 9.97, 8.89. Pertinent too is the article by Professor Trotter, of Swarthmore College, on *The Terminology of Anatomy*, 11.131-134.

C. K.

A CHEMICAL INTERPRETATION OF LIVY 21. 37. 2¹

Pittsburgh is the laboratory as well as the workshop of the world, and the odor of chemicals penetrates even into the Latin class-room. We have in the University of Pittsburgh the Mellon Institute of Industrial Research, designed to bind together science and industry. To-day it goes one step further, and links together science and the Classics, for the technical

¹This paper was read at the Sixteenth Annual Meeting of The Classical Association of the Atlantic States, at the University of Pittsburgh, April 29, 1922.

information behind this paper has been largely furnished by Messrs. W. A. Hamor and E. W. Tillotson, Assistant Directors of the Institute.

When I read Livy with a class, I always plan to read at sight the description of the descent of the Alps. Few scenes in all literature are more graphically described, few episodes in all history are more thrilling. We see weary soldiers, almost exhausted by their difficult and dangerous ascent, resting at the summit, now and then welcoming the stragglers that have finally caught up with the column. A fresh snowfall increases their difficulties and hardships. But the general leads his weary and discouraged little band to a promontory from which a view of the plains about the Po can be gained, and tells them that a short and easy descent, a battle or two, will give them possession of all Italy and even of Rome herself².

The army now resumes its descent by a route that is made easier by its leader's promise of a success not far away. Even the most jaded, sophisticated, and world-weary freshman sits up with renewed interest at what follows. I describe the scene in something like Livy's own language. The column is crawling slowly down the road, gradually elongating as the difficulties of the march accumulate. But suddenly the van is checked. We see the column piling up in the narrow pass as the units in the rear catch up with the advance. The word comes back along the line that the road is blocked by a fresh landslip that has carried away the face of the cliff, leaving the army confronted by a sheer perpendicular precipice a thousand feet in height. Hannibal himself hurries forward. 'What was done, what to do—a glance told him both'. He sends part of his force to try a roundabout way over a glacier. The new snow, lying on top of the old crust, is rapidly converted into slush by the feet of men and animals. The men slip and fall. The animals break through and are trapped in the holes they themselves have made in the old crust. So they are forced back upon the precipice where a road had once been. The soldiers clear away the snow from it, build a huge bonfire, pour vinegar on the heated rock, thus softening it so that they can work it with their tools. So they make a new road easy enough in its grade for the army and even for the pack train.

The passage bristles with difficulties and the class bristles with questions. How could snow stick to the face of a perpendicular cliff? How, for that matter, could a fire be built there? How could the soldiers gain a foothold on it to clear away the snow and build the fire? What kind of rock will respond to such treatment? Where did the vinegar come from to disintegrate the rock? Would not water have done equally well in cracking by sudden contraction the

heated stone? What was the substance that Livy calls vinegar?

We may separate these questions into families, and our inquiry follows the same divisions. First we may consider the thousand-foot precipice. Polybius (3.54) tells the story in very similar language, but with one important difference: he says merely that about a thousand feet of road had been carried away, and this at once suggests that perhaps, in the text of Livy, we should emend *in altitudinem* to *in latitudinem*. But I have as yet no absolutely certain case in Livy where *latitudo* means clearly 'horizontal distance' and I therefore refrain from insisting on the point at present. Our uncertainty is increased when we find that *in pedum mille* is an emendation of the Renaissance scholar Valla (the MSS readings are: C, *impeditus dum ille*; M, *impeditus cum illo*). The emendation is so reasonable, in the light of the statement in Polybius, that it has been universally accepted, but the corruption here makes it easier to believe that there may be more corruption in the same sentence (21.36.2). Polybius was so much nearer the event in point of time, and so much better informed as to Hannibal's route that we are justified in not insisting on the thousand vertical feet, and so we get rid of the first group of questions. Polybius, we are told, visited the Alps to determine the pass that Hannibal used. He is no more specific than to say that the construction of the road required 'infinite toil'. The answers to the other questions are not much affected by this decision. The difficulty of building the road is great enough on any theory. Before leaving this point I wish to quote a description of Alpine scenery (Ball, *Western Alps*, revised edition, by Coolidge, 106):

The view from the Col toward Susa lies down the uppermost narrow portion of the Clarea valley. . . . In ½ hour the traveller reaches the little rocky basin known as the Plan du Clapier and traversed by the Clarea. The view from this point is extremely interesting. From the verge of the precipitous rocks that fall away immediately below him, the traveller sees the lower valley of the Clarea or Clairée, 3,000 feet beneath him, . . . and beyond it <the Touillies range> the ranges that enclose the valley of the Dora Riparia on the S.

If this is actually the place where Hannibal crossed, as I am inclined to believe, Livy's story of the thousand-foot precipice is less incredible. The narrative of Polybius also fits this place. I hope to examine this whole question in greater detail later.

A note in THE CLASSICAL WEEKLY 15.168 relates experiences with breaking stones by heating them and then dashing cold water on them. The author believes that Hannibal used water and not vinegar; he is perhaps influenced by Gulliver, who states gravely that Hannibal himself assured him that he had not a drop of vinegar in his whole camp (Travels, Part 3, Chapter 7). This brings us to the second group of questions, concerning the method of disintegration of the rock. The ancient authorities disagree, as we have seen, as to the nature of the place where Hannibal descended. Polybius does not mention the use of fire and vinegar, but the story was so generally accepted by

²It is not my purpose just now to examine this story: it is perfectly simple to declare this and the rest of the narrative that I am to discuss pure fiction, as many critics have done. I prefer, however, not to reject the statements of ancient historians if any reasonable explanation of them can be found or devised. Students of military geography disagree as to whether any place can be found on any of Hannibal's possible routes where such a view can be gained. I am myself convinced, as far as one can be without a personal inspection of the region, that Livy's story—which is essentially that of Polybius also—is true.

antiquity that it can not be utterly ignored. Mr. Herbert Hoover (in his translation of Agricola's *De Re Metallica*, 118, n. 14: see *THE CLASSICAL WEEKLY* 9.182-183) makes the following generalization on the passage and the discussion thereof:

...the real scholars have passed over the passage with the comment that it is either a corruption or an old woman's tale, but...hosts of soldiers who set about writing the biography of famous generals and campaigns almost to a man take the passage seriously, and seriously explain it by way of the rock being limestone or snow, or by the way of explosives, or other foolishness.

Nevertheless I shall run the risk of excluding myself from the real scholars, and shall perhaps add to the foolishness, as ancient writers did. Thus Appian (8.1.4) tells the story even more circumstantially than Livy did. Juvenal (10.153) made it a matter of declamation. Silius Italicus (3.642), Ammianus (15.10.11) and Servius (ad Aen. 10.13) all mention it. No doubt these all borrowed it from Livy, as Mr. Hoover and others think, but the clear statement in Pliny the Elder (23.57, and elsewhere) can not be so easily set aside: <acetum> saxa rumpit infusum, quae non ruperit ignis antedens³. The process of using fire and some liquid is thus sufficiently vouched for, no matter how doubtful we may be as to the actual liquid used. So too, in the sixteenth century, Agricola, discussing assaying, in the seventh book of his *De Re Metallica* (Hoover, 231), says that the hardest rocks are sprinkled with vinegar that they may be more easily softened, and reports the use of the lees of vinegar as a flux (Hoover, 234).

The effect of fire and water on various stones has in recent years been made the subject of scientific experiment (see McCourt, *Fire-Resisting Qualities of Some New Jersey Building Stones*, State Geologist's Report for 1906, and *Fire Tests of Some New York Building Stones*, Bulletin 100 of the New York State Museum for 1906, and the references cited therein).

Of the various methods used in these tests one seems to approximate the conditions of Hannibal more closely than the others. In this a three-inch cube is heated in an oven to a temperature of 550 degrees Centigrade, taken out, and then cooled suddenly by playing on it a stream of water. It is doubtful whether Hannibal could have produced so high a temperature as this, but these experiments, as well as experience in bad city fires, demonstrate the damage that may be done to rock by heating and sudden cooling. There is other testimony too as to the effect of water on hot stone. Merrill (*Stones for Building and Decoration*, 394, note) says that an "ancient and well-known method" of breaking stones consists in striking or throwing cold water on a heated stone. He also says that the Romans sprinkled hot stones with vinegar, but does not know whether this accelerated the splitting or gave direction to the cracks. According to the same author, the same method was used by the ancient Peruvians. Lines of cleavage may be marked out on heated quartz by laying a wet cord on the stone. In modern practice

in cutting granite, a stream of cold water plays on the stone, but this apparently is done to cool the saws rather than to aid in their operation.

Different kinds of stone react differently to this treatment. The geology of the various passes that Hannibal might have used will be the subject of a separate discussion. On these passes gneiss, secondary slates, sandstone, and calcareous schists are the most important for our purposes. Of these, only the last variety is much affected by heating and cooling, according to the tests previously mentioned. A pure limestone is little affected by sudden cooling unless the point of calcination has been reached at a temperature of 600-700 degrees Centigrade. But these rocks are not pure limestone, and these impure stones disintegrate badly under this treatment. The different elements respond unevenly, and this affects the surface far more than would be true of a homogeneous stone. This particular line of evidence points to the Col du Clapier as the pass which Hannibal used (for other arguments in favor of this pass, see Wilkinson, *Hannibal's March*)⁴.

There is, then, nothing incredible in the story that Hannibal heated the rocks and then softened them with some liquid. The difficult part comes in when we consider the enormous quantity of wood required to bring to a high temperature about 6,000 square feet of stone surface. Fire alone is said to have a great effect on certain stones, while nature unaided breaks off huge masses of stone through the natural variation of temperature from season to season. This of course requires long periods of time (Merrill, *Rocks, Rock-Weathering, and Soils*, 160, and note).

This brings us to ask whether a more powerful liquid than water would have simplified the problem, by accomplishing disintegration at a lower temperature or otherwise. Thus we come to our third group of questions, those dealing with the meaning of *acetum* in the Livy passage.

The first method of dealing with the story is to dismiss it as pure fiction, the invention of Livy or of his source, copied and transmitted through literary channels. This will not, however, satisfactorily account for the powers attributed to vinegar by serious semi-scientific writers, such as Pliny and Vitruvius. To explain their statements we must accept the existence of a substance called by them *acetum*, and attempt to determine its nature and its characteristics.

Acetum appears regularly to be wine vinegar, or possibly sometimes merely sour wine. Its essential constituent is, therefore, acetic acid, the only acid, in the chemical sense, known to antiquity. The extent and the range of its uses may be learned from a glance at the word in the *Thesaurus Linguae Latinae*. It has certain medicinal properties, it dissolves pearls, it is

⁴In *The Classical Journal* 17 (1922), 446-453, 503-513, Professor Glanville Terrell, of the University of Kentucky, discusses again Hannibal's Pass Over the Alps. He has no patience with Livy, but ranks Polybius high. He believes that "the route up the Isère and over the Little St. Bernard fulfils every requisite for Hannibal's pass according to Polybius; that every other pass fails in some important particulars..." For an argument that Hannibal crossed by the Col du Clapier see Paul Azan, *Annibal dans les Alpes* (Paris, 1902).

³Vitruvius (8.19) says that fire and vinegar will break even lava.

a salad dressing, and has other food uses (it is part of a soldier's rations, apparently of his emergency rations too), and it has various uses in the arts, the most important for our purpose being in the treatment of stones of certain types. After the classical period, we find in Agricola, as already noted, its use in assaying. We must conclude either that different substances are meant by *acelum* and that these were carelessly confused by Pliny and Vitruvius, or that *acelum* is actually vinegar, for no other one thing will so nearly meet the description as vinegar.

Let us return to Hannibal's pass. Let us further assume that he crossed by the Col du Clapier, where the rock is largely calcareous schist. We may think that the landslip left a broken, irregular surface, with numerous crevices where a liquid could lodge and so penetrate into the more solid rock below. The only stone upon which acetic acid acts readily is limestone, out of which it removes the calcium. Heating will accelerate the reaction somewhat, but at any rate the acid would act at a far lower temperature than would water. Even a small amount of acid would start a softening process which would make the rock far more easily workable by tools than it had been before. Such a thing would make a good story, and might easily develop into a tradition of the sort that Livy follows, a tradition that seemed to say that the whole surface was so treated. It may have been, but this is not a necessary part of the story. I believe, then, that Hannibal did use vinegar. I do not know how much: to soften the entire roadway would have demanded a quantity of vinegar almost beyond credibility. Dio (36.18) tells us that traitors in Eleuthera, when the town was under siege, saturated a brick tower and thus rendered it weak enough to be overthrown. This might have been effected in two ways, by the action of the acid on mortar, if the tower was so built, or by the action of the acid on the porous, sundried brick out of which the tower was probably constructed. When once the power of vinegar to dissolve limestone was established, unscientific writers might easily attribute to it similar powers over other kinds of stones that were really immune. I admit at once that this is not altogether satisfactory. Pliny may be excepted, but Vitruvius was a practical architect, presumably familiar with the properties of building stones, and it is hard to see how he could have been so badly mistaken. But mineralogy was not a science that had been highly developed by the Romans (compare Moore, *Ancient Mineralogy*, 1), and their nomenclature may have been at fault. So it appears to have been in a passage of Ovid (*Met.* 7. 107-108) where *silex* is used of limestone, though this may be mere poetic license.

One more conjecture should be considered. Hennébert (*Vie d'Annibal*, 2.253 ff.) and Morris (*Hannibal*, 100) believe that what Livy calls *acelum* was an explosive (compare Felice Ferrero, *The Valley of Aosta*, 143 ff.; I owe the reference to Professor Knapp). Probably the only thing known to antiquity that might be so described was Greek fire, presumably a

mixture of sulphur with asphalt or another bitumen-product. That this had any rending power is doubtful; that it produced heat is certain; that it could act as a solvent and function in the other ways described by our authorities is impossible. I shall discuss the question elsewhere. It must be regarded as a possibility, however, that Hannibal used this in building his road.

It appears, then, that we may accept Livy's narrative as it stands, except the perpendicular thousand-foot cliff, which should probably be regarded as a steep descent on which a thousand lineal feet of road had been carried away. As Hannibal had acetic acid, in the form of vinegar or sour wine, and as acetic acid is a solvent for certain kinds of stone, we may accept that part of the story, and we are then led to the conclusion that Hannibal crossed by the Col du Clapier, for there conditions would have been most favorable for this method, and apparently only there could such a method have been used with any prospect of success. A more complete examination of the arguments for this pass will be given at another time. Despite the critics, there is nothing inherently impossible or even improbable in Livy's narrative, except that it is not expressly confirmed by Polybius.

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MODERN PARALLELS TO LIVY 21.37. 2-3

A newspaper report of forest fires, under date of November 9, 1922, says:

A state forestry report just made tells of fire being spread by bursting stones which were in the path of fires and were heated to such an extent that they flew into pieces.

A still more interesting instance is found in an article entitled *The Land of the Free in Africa*, in *The National Geographic Magazine* 42.425-426 (October, 1922). In describing a remarkable road built through the jungle, the author, Mr. Harry A. McBride, says:

Huge boulders of rock would come to light, often in the exact center of the roadway. No tackle, chains, or tractors were available; so great fires were built in trenches dug around the rocks, heating the stone until it cracked, and, piece by piece, could be removed.

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REVIEWS

Etruscan Tomb Paintings: Their Subjects and Significance. By Frederik Poulsen. Translated by Ingeborg Andersen. New York: Oxford University Press, American Branch (1922). Pp. x + 63; Figures 47. \$5.65.

The importance of this book is as great as the number of its pages is small. At last a book exists in English that gives a clear and satisfactory discussion of the chronology and the meaning of the fascinating frescoes on the walls of the chamber tombs of Etruria, couched in a style that makes it a pleasure for the scholar and the layman alike to read. The distin-